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(54) A chair tilting mechanism

(57) A chair mechanism (1) has a seat support (11) and a backrest support (50) which can pivot about pins on a fixed support (2). They are interconnected so that their tilting is synchronised. A lock (30) locks the seat support (11) at a certain tilt position with respect to the fixed support (2) and therefore in turn locks the backrest support. The lock (30) has lock members (36, 37) with ridges or teeth which interengage to provide positive mechanical locking. The teeth are configured so that tilt bias which is provided by a bias unit (15) urges the teeth into tighter locking engagement once they are engaged. Therefore, accidental release of the actuator does not cause the lock to become released and therefore jerking actions of parts of the chair are avoided. For releasing of the lock, it is necessary for the user to urge parts of the chair against the tilt bias, thereby causing release surfaces on the teeth to slide with respect to each other to urge the locking member (37) away from the locking member (36). The slopes of the surfaces on the teeth are important as they provide for tighter mechanical engagement under the tilt bias and for disengagement when the user urges a chair part against the tilt bias.

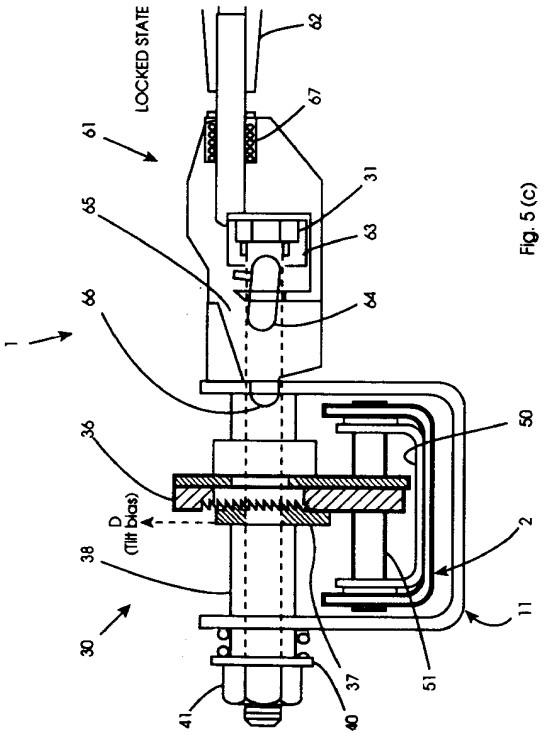

Fig. 5 (c)

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Description

The invention relates to chair tilting mechanisms of the type comprising supports for connection to parts of a chair such as a seat, a backrest or an armrest to permit mutual tilting of the parts. More particularly the invention relates to a chair tilting mechanism of the type for connection to a chair to control mutual tilting of parts of the chair and comprising:-

a fixed support for connection to a ground-engaging portion of a chair;

a pivot joint connected to the fixed support;

a tilting support pivotally connected by the pivot joint to the fixed support for tilting movement in a tilting plane;

a tilt bias means mounted between said tilting and fixed supports for biassing said tilting support in a tilt bias direction to a default, home position; and

a lock mounted between said fixed and tilting supports.

Such a mechanism is described in PCT Patent Specification No. WO 93/17602.

In design and production of chair tilting mechanisms a traditional problem has been the extent of the stresses which arise in the components of the mechanisms arising from the leverage forces applied by the chair parts such as the backrest. Where the tilting mechanism includes a lock to hold one or more chair parts at particular tilt positions, very high lock bias forces have been required in order to counteract the leverage forces involved.

Examples of such mechanisms are those described in British Patent Specification No. GB 2,193,884 and German Patent Specification No. DE 2,647,410.

Further, a safety problem arises in use of chairs incorporating tilting mechanisms of the prior art where the mechanism provides a tilt bias. For example, in PCT Patent Specification No. WO 93/17602, a spring unit mounted at the front of the mechanism biasses a seat support about a fixed support in the direction whereby the front of the seat support is urged downwardly. The lock for this mechanism is a friction clutch. The seat may be tilted by the user against the spring bias to a particular position and then locked. If the lock is then released in an incorrect manner, there may be a sudden jolting movement of the seat forwardly. As the backrest is connected to the seat support, it may have a large jolting movement which can possibly cause injury.

A still further problem with existing chair tilting mechanisms is that the locks comprise a large number of parts, usually over twenty clutch leaves and associated clamping devices. This can lead to high expense in the manufacturing operation, particularly as the clutch leaves and clamping devices must be manufactured to a very fine tolerance for correct operation.

An object of the invention is to provide a chair tilting mechanism which is of simpler construction than heretofore.

Another object is that the tilting mechanism provides a safe manner of unlocking a chair tilting part which is biassed to a home position.

The invention is characterised in that said lock comprises:-

a lock member connected to the fixed support, and a lock member connected to the tilting support, said lock members being mounted for mutual movement in the tilting plane, and for mutual movement substantially perpendicular to the tilting plane for engagement and disengagement;

a lock actuator having means for causing mutual movement of the lock members into engagement for a locked state; and

formations on the lock members for interengagement in said locked state, said formations having engaging surfaces for positive mechanical engagement and having a shape whereby the tilt bias means acts to maintain the lock in the locked state if the lock actuator ceases to act.

By providing for positive mechanical engagement, the mechanism can much more easily handle the high stresses in use. This leads to reliability. Further, by providing formations shaped to allow the tilt bias means maintain the lock members engaged, a major improvement in safety is achieved. The tilt bias is generally quite strong, and in prior art mechanisms, it can cause a severe jolting movement of a tilting part if the lock is accidentally disengaged. In the chair mechanism industry, reduction of the required number of components and simplification of assembly is very important. In the invention, improved safety and reliability have been achieved together with simpler construction. This is a very important point. Indeed, simplicity of construction and the fact that the tilt bias unit of existing mechanisms is put to a new use are extremely important.

In one embodiment, the engaging surfaces of at least one lock member extend in a direction which has a directional component in the tilt bias direction parallel to the tilting plane. This is a particularly suitable way of allowing the tilt bias means maintain the lock members engaged.

In one embodiment, said formations further comprise release surfaces extending towards their extremities in a direction having directional components parallel to, and perpendicular to the tilting plane for sliding engagement to cause mutual movement of the lock members away from each other upon user movement of the tilting support against the tilt bias direction, to release the lock. This allows the user to release the lock in a safe manner without the need for an auxiliary releasing mechanism. All that this feature requires is appropriately shaped formations.

Preferably, said engaging surfaces extend at an angle in the range of 2° to 25° from perpendicular to the tilting plane, and said release surfaces extend at an angle in the range of 15° to 50° from perpendicular to the tilting plane.

In one embodiment, the lock member formations comprise ridges.

In one embodiment, the lock members are pivotally connected to their associated supports.

In one embodiment, the mechanism further comprises a guide means comprising means for guiding the lock members in alignment to maintain them in registry during tilting.

The guide means preferably comprises guide members abutting side edges of the lock members to maintain them in alignment.

In one embodiment, the mechanism further comprises a lock spring comprising means to provide a separation bias between the locking members sufficient to prevent undesired engagement.

In one embodiment, said mechanism comprises a seat tilting support and a backrest tilting support, and wherein all supports are interconnected for synchronised tilting, whereby locking of a tilting support causes locking of the or each other tilting support.

According to another aspect, the invention provides a chair tilting mechanism for connection to a chair to control mutual tilting of parts of the chair, the mechanism comprising:-

a fixed support for connection to a ground-engaging portion of a chair;

a pivot joint connected to the fixed support;

a tilting support pivotally connected to said fixed support by said pivot joint for tilting movement in a tilting plane;

a tilt bias means mounted between said tilting and fixed supports for biassing said tilting support in a tilt bias direction to a default, home position; and

a lock mounted between said fixed and tilting supports, characterised in that the lock comprises:-

a lock member connected to the fixed support, and a lock member connected to the tilting support, said lock members being mounted for mutual movement in the tilting plane, and for mutual movement substantially perpendicular to the tilting plane for engagement and disengagement;

a lock actuator having means for causing mutual movement of the lock members into engagement for a locked state; and

formations on the lock members, wherein:-

said formations having engaging surfaces for positive mechanical engagement and have a shape whereby the tilt bias means acts to maintain the lock in the locked state if the lock actuator ceases to act, said engaging surfaces on at least one lock member extend in a direction which has a directional component in the tilt bias direction parallel to the tilting plane; and

said formations have release surfaces extending towards their extremities in a direction having directional components parallel to, and perpendicular to the tilting plane for sliding engagement to cause mutual movement of the lock members away from each other upon user movement of the tilting support against the tilt bias direction to release the lock when the actuator ceases to act.

In a further aspect, the invention provides a chair synchronised tilting mechanism for connection to a chair to control mutual synchronised tilting of parts of the chair, the mechanism comprising:-

a fixed support for connection to a ground-engaging portion of a chair;

a plurality of tilting supports;

pivot joints between the tilting and fixed supports to provide synchronised tilting of the tilting supports;

a tilt bias means mounted between said tilting and fixed supports for biassing said tilting supports in a tilt bias direction to default, home positions; and

a lock mounted between said fixed and tilting supports, characterised in that said lock comprises:-

a lock member connected to the fixed support, and a lock member connected to a tilting support, said lock members being mounted for mutual movement in the tilting plane, and for mutual movement substantially perpendicular to the tilting plane for engagement and disengagement;

a lock actuator having means for causing mutual movement of the lock members into engagement for a locked state; and

formations on the lock members for interengagement in said locked state, said formations having engaging surfaces for positive mechanical engagement and having a shape whereby the tilt bias means acts to maintain the lock in the locked state if the lock actuator ceases to act.

In a still further aspect, the invention provides a lock for a chair tilting mechanism for connection to a chair to control mutual tilting of parts of the chair, the mechanism being of the type comprising:-

a fixed support for connection to a ground-engaging portion of a chair;

a pivot joint connected to the fixed support;

a tilting support pivotally connected to said fixed support by said pivot joint for tilting movement in a tilting plane; and

a tilt bias means mounted between said tilting and fixed supports for biassing said tilting support in a tilt bias direction to a default, home position,

characterised in that the lock comprises:-

a lock member for connection to said fixed support;

a lock member for connection to said tilting support;

connection means for connecting said lock members to their associated support, said connection means having means for allowing mutual movement of the lock members in the tilting plane and for allowing mutual movement substantially perpendicular to the tilting plane for engagement and disengagement,

an actuator having means for causing mutual movement of the lock members into engagement for a locked state; and

formations on the lock members for interengagement in said locked state, said formations having engaging surfaces for positive mechanical engagement and having a shape whereby the tilt bias means acts to maintain the lock in the locked state if the actuator ceases to act.

The invention will be more clearly understood from the following description of some embodiments thereof,

given by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective and partially cut-away view from one side of a chair tilting mechanism of the invention;

Fig. 2(a) shows components of a lock of the mechanism in perspective view, and Figs. 2(b) to 2(d) additionally show some of the components in front and side view;

Fig. 3(a) is a partly cut-away cross-sectional view from the front of the mechanism showing part of a lock member of the mechanism, and Fig. 3(b) is a diagrammatic view from the same direction of an alternative set of formations;

Figs. 4(a) and 4(b) are diagrammatic side views showing the mechanism in operation;

Figs. 5(a), 5(b) and 5(c) are diagrammatic and cross-sectional rear views showing the mechanism in operation; and

Figs. 6(a) and 6(b) are diagrammatic side views showing movement of locking members between extreme tilting positions, and

Fig. 7 is a diagrammatic side view showing overall configuration of an alternative mechanism of the invention.

Referring to the drawings, and initially to Fig. 1, there is shown a chair tilting mechanism of the invention, indicated generally by the reference numeral 1. The mechanism 1 is of the synchronised tilting type to allow a chair seat and backrest tilt in a synchronised manner and to provide a tilt bias to a default, home position. The mechanism comprises a fixed support 2 which has a socket 3 for reception of a spindle connected to casters or feet of a chair. The fixed support 2 provides a fixed datum for the mechanism 1 when connected to such a spindle.

A pivot connector, namely a fixed pivot pin 10 extends through the fixed support 2 and outwardly on each transverse side of it to engage a tilting seat support 11 of channel-shaped construction. This provides a pivot joint between the fixed and seat supports. The seat support 11 extends around the fixed support 2 and terminates in upper horizontal flanges 12 having apertures 13 for connection to a chair seat.

A tilt bias unit 15 is mounted at the front end of the mechanism 1. This is mounted to bias the seat support to a default, home position and comprises a cylindrical stop member 16 engaging a curved seat 17 extending across the seat support 11. The stop member 16 has a threaded socket engaging a bolt 18 which connects with the fixed support 2 via a cylindrical housing 19. The housing 19 surrounds a coil spring 20 which urges the stop member 16 downwardly against an anchorage underneath the fixed support 2. Tension in the spring 20 may be adjusted by rotation of the bolt 18 by use of an adjustment knob 21.

The seat support 11 may be locked at a particular desired tilt position by use of a lock 30 mounted between the fixed support 2 and the seat support 11.

Further, the mechanism 1 comprises a tilting backrest support 50 which extends into the seat support 11 and into a channel-shaped rear part of the fixed support 2 to engage a fixed support pin 51. This provides a pivot joint between the fixed and backrest supports. The backrest support 50 also engages against a lower abutment pin 52 extending across the seat support 11. Further, there is an upper stop pin 53 extending across the seat support 11 to prevent lifting of the backrest.

The user may shift his or her weight to cause the seat and backrest to tilt in a synchronised manner against the tilt bias. When desired, they may be locked at a desired tilt position by actuating the lock 30. For clarity for further description of the mechanism and its operation, the tilting supports are regarded as tilting in a tilting plane which extends vertically and longitudinally through the mechanism. This is, of course, perpendicular to the axes of the pivot joint pins 10 and 51.

Referring now to Figs. 2 and 3, construction of the lock 30 is shown in detail. The lock 30 comprises a bolt 31 which extends across the seat support 11 and outwardly at each transverse side. A sleeve spacer 32 surrounds the head end of the shank of the bolt 31 and abuts against a side wall of the seat support 11.

At it's inner side, the spacer 31 abuts against a guide 33. The guide 33 comprises a base plate 33(a) which has an upper longitudinal slot 33(b) through which the bolt 31 extends. The base plate 33(a) also comprises a lower aperture 33(c) which engages the fixed pin 51. Finally, the guide 33 comprises a pair of guide members 33(d) which extend transversely across the mechanism. Accordingly, the guide members 33(d) extend perpendicularly to the tilting plane.

Returning to the sequence of parts of the lock 30, there is a washer 34 which acts as a seat for a helical spring 35 which extends through a lock member 36 for engagement with a lock member 37. For clarity, the lock member 36 is hereinafter referred to as a ratchet, and the lock member 37 is hereinafter referred to as a pawl as they bear some resemblance to such components. This resemblance derives from the fact that the pawl "bites into" the ratchet for locking, although they are not, of course, a ratchet and pawl in the strict sense.

The ratchet 36 comprises a plate 36(a) which has an upper elongate slot 36(b) through which the bolt 31 and the spring 35 pass. It also has a lower aperture 36 (c) which engages the fixed pin 51. Finally, the ratchet 36 comprises an integral set of formations, namely, ridges or teeth 36(d) which are not symmetrical but generally extend downwardly, as described in more detail below.

The pawl 37 comprises a plate 37(a) having an aperture 37(b) through which the bolt 31 extends. Around the aperture 37(b), there is an annular seat 37(c) for the end of the spring 35. The seat 37(c) is recessed into a set of formations, namely, elongate ridges or teeth 37(d) which again are not symmetrical but extend generally upwardly for engagement with the teeth 36(d) on the ratchet 36.

The lock 30 also comprises a spacer sleeve 38 which extends through a side wall of the seat support 11, and around which a light coil spring 39 is mounted for action between the side wall of the seat support 11 and a washer 40, which in turn engages a nut 41 threaded to the bolt 31.

The particular configuration of the teeth 37(d) of the pawl 37 is shown in more detail in the front view of Fig. 3(a). As the teeth 36(d) of the ratchet 36 are shaped to correspond with these teeth, they follow from description of the teeth 37(d). Each of the teeth 37(d) comprises an upper engaging surface 37(e) for engagement with a corresponding surface on a ratchet tooth 36(d). Starting from the plate 37(a) of the pawl 37, each engaging surface extends in a direction having a major directional component perpendicular to the tilting plane and a minor directional component (caused by an angle of 5°) in the tilting plane. The latter component is upwardly in the bias direction applied by the tilt bias unit 15 (anticlockwise about the fixed pin 10 as viewed in Fig. 1). Returning again to Fig. 1, it will be seen that the tilt bias unit 15 provides a downward force on the front of the seat support 11 and thereby an upward force at the rear of the seat support 11 where the lock 30 is located. Thus, the component of the direction of the engaging surface 37 (e) which is in the tilting plane is in the direction of bias.

Beneath the engaging surface 37(e), there is a release surface 37(f) which extends in a direction having a component perpendicular to the tilting plane and a component in the tilting plane. In this case, the angle of the release surfaces 37(f) to perpendicular to the tilting plane is 29.3°. As is also clear from Fig. 3, the pitch of the teeth 37(d) is 2.0 mm and the depth of the teeth is 2.25 mm.

As is clear from Figs. 1 to 3, the ratchet 36 and pawl 37 have mutual movement in the tilting plane during tilting of the chair parts. This is because the bolt 31 brings the pawl 37 with it as it pivots about the fixed pin 10, but not so the ratchet 36 as it passes through a slot in the ratchet 36. Further, there is mutual movement in and out perpendicular to the tilting plane caused by movement of the pawl 37 on the bolt 31 for engagement and disengagement.

It is important that the angle of the engaging surface 37(e) does not hinder the mutual transverse movement for engagement of teeth of the pawl and ratchet and it is preferably in the range of 2° to 25°, depending on the nature of the materials used. The angle of the release surfaces 37(f) is preferably much larger and while in this embodiment it is 29.3°, it may be in the region of 15° to 50° again depending on frictional characteristics of the material. The teeth are all of broached steel construction to provide the necessary strength and friction characteristics. However, they could be of sintered or moulded construction, for example.

Referring to Fig. 3(b), an alternative configuration of formations is shown. A fixed support lock member 40 has formations with engaging surfaces extending perpendicular to the tilting plane, while a tilting support lock member 41 has formations generally similar to those of the pawl 57. It will be appreciated that the formations of the lock members could be of any suitable shape to allow positive mechanical engagement, and the tilt bias to maintain them engaged as a back-up to the actuator.

As shown in most detail in Figs. 5(a) to 5(c), the lock 30 further comprises an actuator 61 to cause movement of the bolt 31 in and out for engagement and disengagement of the ratchet and pawl. In this embodiment, the actuator 61 comprises a handle 62 and a socket 63 which receives the head of the bolt 31. The socket 63 also provides a seat for a compressive toggle member 64, the other end of which is engaged with an actuator body 65 which has lugs 66 located within apertures in the side wall of the seat support 11. A spring 67 is mounted between the actuator body 65 and the handle 62.

The function of the actuator 61 is to move the bolt 31 in and out perpendicular to the tilting plane to cause engagement of the ratchet and pawl. It has two toggle states, namely, a locked toggle state at which the toggle member 64 is in compression urging the pawl 37 against the ratchet 36, and an over-centre toggle release state at which the toggle member 64 is not under compression and the pawl 37 is not biassed to the locked position by the actuator 61. It will be appreciated that any suitable type of actuator which performs this function would be suitable.

It will be clear in particular from Fig. 2 that the lock 30 is of modular construction as it may be easily fitted in existing mechanism designs. This is achieved by simply connecting the actuator 61 and the bolt 31 together with its components onto a support of channel-shaped construction, and connecting the ratchet 36 to an appropriate fixed pin.

Accordingly, existing mechanism designs having friction-leaf clutches may have the lock of the invention fitted quite easily instead.

In operation, referring to Figs. 4 to 6 inclusive, and initially to Figs. 4(a) and 4(b), the seat support 11 is connected to a seat 70, the backrest support 50 to a backrest 71 and the fixed support 2 to a chair spindle 72. As the seat support 11 can tilt about the fixed pin 10 and the backrest support 50 can tilt about the fixed pin 51, both may be regarded as tilting supports, the fixed support 2 being, of course, fixed in position on the spindle 72 of the chair. The home position is shown in Fig. 4(a) at which the seat support 11 has tilted to the limit in the clockwise direction about the fixed pin 10. Through the action of the lower abutment pin 52, the seat support 11 has

caused the backrest support 50 to rotate in the clockwise direction about the fixed pin 51 to its limit position. The upper stop pin 53 does not play any part in the tilting action - it simply prevents the backrest from being individually lifted from behind, etc. At the home position, the lock 30 is usually in the released state.

While leaving the lock 30 released, the user may lean backwards in the chair, thereby urging the backrest 50 in the anti-clockwise direction about the pin 51 and the seat support 11 in the anti-clockwise direction about the pin 10. Because of the interconnection between the backrest support 50 and the seat support 11 via the fixed support 2 and the lower abutment pin 52, this tilting action is synchronised. The tilting action is against the bias of the tilt bias unit 15 which continues to urge the tilting supports to the default, home position. In Fig. 4(b), the home position is indicated generally by interrupted lines and the new tilt position by full lines. After tilting in this manner, the user may actuate the lock, causing the pawl and the ratchet to become engaged to hold the seat and backrest at a particular tilt position.

Referring now to Figs. 5(a), 5(b) and 5(c) and also to Figs. 6(a) and 6(b), the manner in which this is achieved is described in detail. In Fig. 5(a), the mechanism is shown at the home position of Fig. 4(a) with the seat support 11 at its uppermost location in this view. The lock is released and the pawl 37 has moved to its left-most position in this view and therefore its only possible transverse movement is indicated by the arrow A, towards the ratchet 36. The pawl 37 may also move, together with the seat support 11 and everything to which it is attached, in a downward direction, in the tilting plane indicated by the arrow B (anti-clockwise about the pin 10 as viewed in Figs. 4(a) and 4(b)). The upper limit for movement of the bolt 31 (at the home position) is set by the slot 33(b) of the guide 33. In the lock released state as shown in Figs. 5(a) and 5(b), the pawl 37 is maintained at a safe distance from the ratchet 36 by the spring 35, shown most clearly in Fig. 2. This spring has sufficient tension to maintain the pawl 37 at a distance from the ratchet 36 to prevent inadvertent engagement during the lock released state when tilting can occur. The purpose of the outer spring 39 which is outside of the seat support 11 is simply to provide a better "feel" to the actuator 61 and it does not play any further part in operation of the lock 30.

As shown in Fig. 5(b), the lock is still released and the user has tilted the seat and backrest in the anti-clockwise direction as viewed in Fig. 4(b). Again, the pawl 37 may move transversely only in the right-hand direction only indicated by the arrow A, and it may move both up and down in the tilting plane as viewed from the rear and indicated by the arrow C. This represents possible clockwise and anti-clockwise rotation about the pin 10. Again, the spring 35 keeps the ratchet and pawl separate.

As shown in Fig. 5(c), the user has pulled up the handle 62 of the actuator 61, thereby causing the pawl 37 to be pulled to the right as viewed from the rear for engagement with the ratchet 36. Engagement is achieved by the actuator pulling the pawl against the ratchet, and by a slight upward movement of the pawl caused by both the actuator and the tilt bias unit. The actuator 61 maintains the pawl 37 in engagement with the ratchet 36 by virtue of the fact that the toggle member 64 is at the over-centre position and is in compression, thereby urging the pawl 37 to the right via the bolt 31, the sleeve 38, the washer 40 and the nut 41. As is clear from Fig. 5(c), there is a positive engagement of the ratchet and pawl by virtue of the fact that they have teeth with engaging surfaces having directional components perpendicular to the tilting plane. As viewed in Fig. 5(c), the tilting plane is vertical. It will be appreciated that this provides a significant locking effect, which is much more positive than that which has heretofore been the case with friction leaves. The locking is a positive mechanical action which does not rely on friction. In the locked position shown in Fig. 5(c), the pawl 37 is not free to move in the tilting plane and it is also prevented from moving away from the ratchet 36 because of the action of the actuator 61.

The interrupted arrow D represents the direction of bias provided by the tilt bias unit 15. Because the pawl 37 and the bolt and the other components on the bolt move with the seat support 11, tilt bias in the direction of the arrow D is provided via the seat support 11. However, this bias does not act on the ratchet 36 because it does not move with the seat support 11 by virtue of the fact that the bolt 31 extends through an elongate slot 36(b) in it. This is also the case for the guide 33, which has an elongate slot 33(b). In general, the guide 33 and the ratchet 36 are pivotally connected on the fixed pin 51 and are therefore only free to rotate about this pin. They cannot move about any other pivot, unlike the pawl 37 which can move in the direction indicated by the arrows B and C of Figs. 5(a) and 5(b) on rotation of the seat support 11 about the pivot pin 10.

An important aspect of the invention is the configuration of the teeth 36(d) and 37(d). As shown in detail in Fig. 3, the teeth 37(d) of the pawl 37 have an engaging surface 37(e) which extends at an angle of 5° in the direction of bias. The teeth 36(a) on the ratchet 36 have lower engaging surfaces which correspond with this and therefore, the bias in the direction of D provided by the bias unit 15 acts to urge the teeth 37(d) into closer engagement with the teeth 36(d). Accordingly, if the actuator 61 were accidentally disengaged so that it no longer urges the pawl 37 against the ratchet 36, there would still be a positive engagement of the teeth by virtue of the bias provided by the tilt bias unit 15 in the direction of the arrow D. This is seen most clearly in Fig. 5(c) in which the upward inclination of the teeth 37(a) on the pawl 37 and the downward inclination of the teeth 36(d) as shown in this view, provide this "biting" effect. When considering this effect, it must be borne in mind that the drawing of Fig. 3 shows the pawl 37 from the front, whereas the view of Fig. 5(c) shows it from the rear.

This provides a very important safety feature where-

by accidental disengagement of the actuator 61 does not cause the lock 30 to be released and the tilt position is maintained. Another important aspect is that for the lock 30 to be released, it is necessary for the user to urge the backrest and/or the seat in the anti-clockwise direction as viewed in Fig. 4(b) so that the teeth 37(d) of the pawl 37 "slip out" of engagement by sliding contact of the release surfaces 37(f) of the pawl 37 with corresponding upper release surfaces on the ratchet teeth 36(d). The angle of 29.3° provides for effective sliding of the release surfaces against each other. Effectively, downward movement against the bias D provides outward movement in the left-hand direction as viewed in Fig. 5(c) of the pawl 37 to cause them to become disengaged. For this to happen, it is necessary for the user to positively urge the backrest against the tilt bias and it is therefore necessary that the user take a deliberate action to ensure that he or she wishes to release the lock. Once the teeth have been disengaged by this action, the spring 35 keeps them separate so that the tilting parts may tilt about their respective axes as shown in Figs. 4(b) and 5 (b).

To help understand the nature of movement of the ratchet and pawl, reference is now made to Figs. 6(a) and 6(b). For clarity, the pivot pins 10 and 51 which are on the fixed support 2 are to be regarded as fixed and have additionally been indicated by the characters F1 and F2, F denoting that they are fixed. The bolt 31 should be regarded as movable in an arc having a radius R about the pin 10 and is therefore indicated by the characters M1, M denoting that it is movable. The position shown in Fig. 6(a) corresponds with that of Figs. 4(a) and 5(a), i.e. the home position. When the user urges the seat and the backrest in the anti-clockwise direction as shown in Fig. 4(b), the bolt M2 rotates in the anti-clockwise direction about F1. Because M2 passes through the pawl 37, it brings the pawl with it. However, the guide 33 and the ratchet 36 are constrained to rotational motion only, about the fixed pin F2. Therefore, as M2 rotates about F1, the arms 33(d) of the guide (33) rotate the pawl 36 about the bolt M2 to track rotation of the ratchet 36 about the fixed pin F2. In this way, the arms 33(d) of the guide 33 which extend across both the ratchet and the pawl keep the ratchet and pawl in registry with each other at all times.

It will be appreciated that the invention provides a tilting mechanism which has a very simple lock as it has much fewer parts than has heretofore been the case. Further, the locking action is much more positive as there is positive mechanical inter-engagement of formations and friction is not relied upon for the locking action. Further, there is significantly improved safety as accidental disengagement of the actuator does not cause the lock to become released as the tilt bias unit keeps the teeth in engagement. It will also be noted that if the tilt bias has been significantly reduced and becomes less effective at maintaining the lock in the locked state without the actuator, there is then by definition a lower injury risk as a jolting movement would not arise, or would be very slight. The tilt bias unit is something which is required in any event for tilting mechanisms and does not result in use of any further parts to achieve the safety feature.

What has been achieved is much more effective locking with improved safety, and at the same time a requirement for much fewer parts. In the chair mechanism industry, reduction of the number of parts and simpler assembly are extremely important factors as such reductions can significantly affect the commercial success of a particular mechanism. It is an extremely important development when this is achieved while at the same time both locking strength and safety have been improved.

It is also very commercially important that the lock may be easily fitted to existing mechanism designs.

The invention is not limited to the embodiments hereinbefore described. For example, it is envisaged that formations other than ridges or teeth may be provided.

The formations may have any suitable male/female configuration. Further, it is not essential that the locking members be pivotally mounted on their respective supports. For example, they may be large enough to accommodate the full tilting range whereby they are secured to their associated support. In this embodiment, the formations may take the form of a set of studs or projections which can inter-engage at different positions with play allowed. In this case, a guide would not be required to maintain the locking members in registry by allowing only translational relative movement. Indeed, the formations may be of any suitable shape to provide both positive mechanical engagement and also the action of the tilt bias unit to maintain engagement. It is envisaged that engaging surfaces on formations of one or both lock members may be fully perpendicular to the tilting plane provided they have sufficient friction. It is not essential that the formations have release surfaces to allow release of the lock by the user leaning against a tilting part. Lock release could alternatively be achieved by use of an auxiliary release mechanism, possibly having a separate actuator.

Further, the lock may be connected between any required pair of supports and the spring may be of any suitable type such as a leaf spring. For example, the seat support could be fixed, and the lock mounted between it and a tilting backrest support. Referring to Fig. 7, such a mechanism 70 is shown diagrammatically in which a seat support 71 is fixed and a backrest support 72 pivots about a fixed pin 73 on the seat support 71. A tilt bias unit 74 acts on the backrest support 72 forwardly of the fixed pin 73. A lock 75 of the invention is mounted between the backrest and seat supports on the same side of the fixed pin 73. Accordingly, formations of a lock member on the (tilting) backrest support 72 have engaging surfaces directed downwardly as this is the bias direction.

Where the mechanism provides synchronised tilting, this may alternatively be provided as described, for example, in British Patent Specification No. GB

2,255,904.

Claims

1. A chair tilting mechanism for connection to a chair to control mutual tilting of parts of the chair, the mechanism comprising:-
a fixed support (2) for connection to a ground-engaging portion (70) of a chair;
a pivot joint (10) connected to the fixed support;
a tilting support (11) pivotally connected to said fixed support by said pivot joint for tilting movement in a tilting plane;
a tilt bias means (15) mounted between said tilting and fixed supports for biassing said tilting support in a tilt bias direction (D) to a default, home position; and
a lock (30) mounted between said fixed and tilting supports, characterised in that the lock comprises:-
a lock member (36) connected to the fixed support (2), and a lock member (37) connected to the tilting support, said lock members being mounted (31) for mutual movement in the tilting plane, and for mutual movement substantially perpendicular to the tilting plane for engagement and disengagement;
a lock actuator (61, 31) having means for causing mutual movement of the lock members (36, 37) into engagement for a locked state; and
formations (36(d), 37(d)) on the lock members for interengagement in said locked state, said formations having engaging surfaces ((37(e)) for positive mechanical engagement and having a shape whereby the tilt bias means (15) acts to maintain the lock in the locked state if the lock actuator ceases to act.

2. A mechanism as claimed in claim 1, wherein the engaging surfaces (37(e)) of at least one lock member (37) extend in a direction which has a directional component in the tilt bias direction (D) parallel to the tilting plane.

3. A mechanism as claimed in claim 2, wherein said formations further comprise release surfaces (37(f)) extending towards their extremities in a direction having directional components parallel to, and perpendicular to the tilting plane for sliding engagement to cause mutual movement of the lock members (36, 37) away from each other upon user movement of the tilting support (11) against the tilt bias direction (D), to release the lock.

4. A mechanism as claimed in any preceding claim, wherein said engaging surfaces (37(e)) extend at an angle in the range of 2° to 25° from perpendicular to the tilting plane.

5. A mechanism as claimed in claims 3 or 4, wherein said release surfaces (37(f)) extend at an angle in the range of 15° to 50° from perpendicular to the tilting plane.

6. A mechanism as claimed in any preceding claim, wherein the lock member formations comprise ridges (36(d), 37(d)).

7. A mechanism as claimed in any preceding claim wherein the lock members (36, 37) are pivotally connected to their associated supports.

8. A mechanism as claimed in claim 7, further comprising a guide means (33) comprising means for guiding the lock members (36, 37) in alignment to maintain them in registry during tilting.

9. A mechanism as claimed in claim 8, wherein the guide means comprises guide members (33(d)) abutting side edges of the lock members (36, 37) to maintain them in alignment.

10. A mechanism as claimed in any preceding claim, further comprising a lock spring (35) comprising means to provide a separation bias between the locking members (36, 37) sufficient to prevent undesired engagement.

11. A mechanism as claimed in any preceding claim, wherein said mechanism comprises a seat tilting support (11) and a backrest tilting support (50), and wherein all supports (2, 11, 50) are interconnected for synchronised tilting, whereby locking of a tilting support (11) causes locking of the or each other tilting support (50).

12. A chair tilting mechanism for connection to a chair to control mutual tilting of parts of the chair, the mechanism comprising:-
a fixed support (2) for connection to a ground-engaging portion (70) of a chair;
a pivot joint (10) to the fixed support;
a tilting support (11) pivotally connected to said fixed support by said pivot joint for tilting movement in a tilting plane;
a tilt bias means (15) mounted between said tilting (11) and fixed supports (2) for biassing said tilting support in a tilt bias direction (D) to a default, home position; and
a lock (30) mounted between said fixed and tilting supports, characterised in that the lock comprises:-
a lock member (36) connected to the fixed support (2), and a lock member (37) connected to the tilting support (11), said lock members being mounted for mutual movement in the tilting plane, and for mutual movement substantially perpendicular to the tilting plane for engagement and disengagement;

a lock actuator (61, 31) having means for causing mutual movement of the lock members into engagement for a locked state; and
formations (36(d), 37(d)) on the lock members, wherein:-
said formations having engaging surfaces (37(e)) for positive mechanical engagement and have a shape whereby the tilt bias means (15) acts to maintain the lock (30) in the locked state if the lock actuator ceases to act, said engaging surfaces (37(e)) on at least one lock member (37) extend in a direction which has a directional component in the tilt bias direction parallel to the tilting plane; and
said formations (36(d), 37(d)) have release surfaces extending towards their extremities in a direction having directional components parallel to, and perpendicular to the tilting plane for sliding engagement to cause mutual movement of the lock members (36, 37) away from each other upon user movement of the tilting support (11) against the tilt bias direction (D) to release the lock when the actuator (61, 31) ceases to act.

13. A chair synchronised tilting mechanism for connection to a chair to control mutual synchronised tilting of parts of the chair, the mechanism comprising:-
a fixed support (2) for connection to a ground-engaging portion (70) of a chair;
a plurality of tilting supports (11, 50);
pivot joints (10, 51) between the tilting and fixed supports to provide synchronised tilting of the tilting supports;
a tilt bias means (15) mounted between said tilting (11, 50) and fixed supports (2) for biassing said tilting supports in a tilt bias direction to default, home positions; and
a lock (30) mounted between said fixed and tilting supports, characterised in that the lock comprises:-
a lock member (37) connected to the fixed support, and a lock member (36) connected to a tilting support, said lock members being mounted for mutual movement in the tilting plane, and for mutual movement substantially perpendicular to the tilting plane for engagement and disengagement;
a lock actuator (61, 31) having means for causing mutual movement of the lock members into engagement for a locked state; and
formations (36(d), 37(d)) on the lock members for interengagement in said locked state, said formations having engaging surfaces for positive mechanical engagement and having a shape whereby the tilt bias means (15) acts to maintain the lock in the locked state if the lock actuator ceases to act.

14. A lock (30) for a chair tilting mechanism for connection to a chair to control mutual tilting of parts of the chair, the mechanism being of the type comprising:-
a fixed support (2) for connection to a ground-engaging portion of a chair;
a pivot joint (10) connected to the fixed support (2);
a tilting support (11) pivotally connected to said fixed support by said pivot joint for tilting movement in a tilting plane; and
a tilt bias means (15) mounted between said tilting and fixed supports for biassing said tilting support in a tilt bias direction to a default, home position,
characterised in that the lock comprises:-
a lock member (36) for connection to said fixed support;
a lock member (37) for connection to said tilting support;
connection means (31, 51) for connecting said lock members to their associated support, said connection means having means for allowing mutual movement of the lock members in the tilting plane and for allowing mutual movement substantially perpendicular to the tilting plane for engagement and disengagement,
an actuator (61, 31) having means for causing mutual movement of the lock members into engagement for a locked state; and
formations (36(d), 37(d)) on the lock members for interengagement in said locked state, said formations having engaging surfaces for positive mechanical engagement and having a shape whereby the tilt bias means (15) acts to maintain the lock in the locked state if the actuator ceases to act.

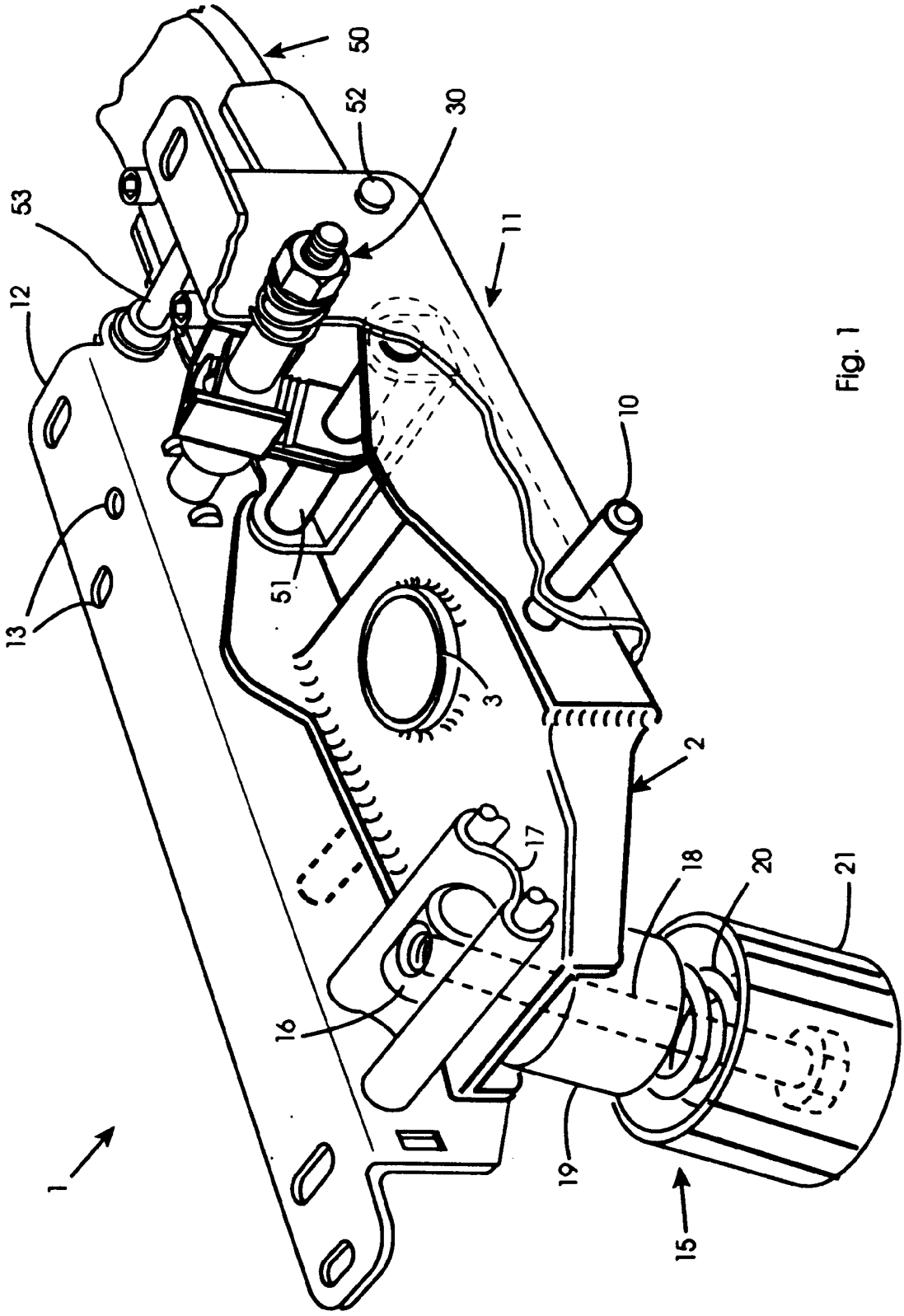

Fig. 1

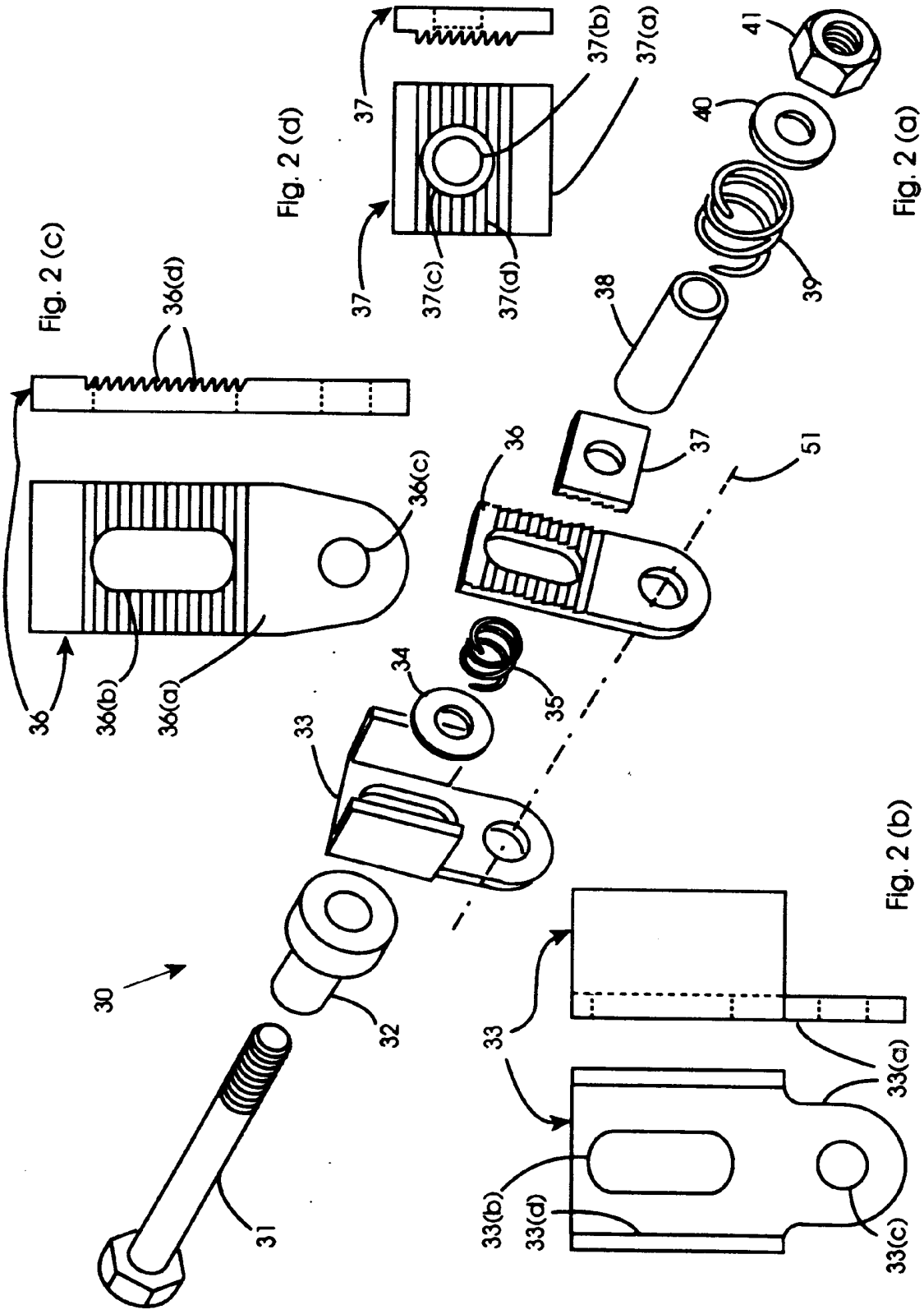
Fig. 2 (a)
41
40
39
38
37
36
51
Fig. 2 (b)
33
33(a)
33(b)
33(d)
33(c)
Fig. 2 (c)
36(d)
36
36(b)
36(a)
36(c)
Fig. 2 (d)
37
37(b)
37(a)
37(c)
37(d)
30
31
32
33
34
35

Fig.3(a)

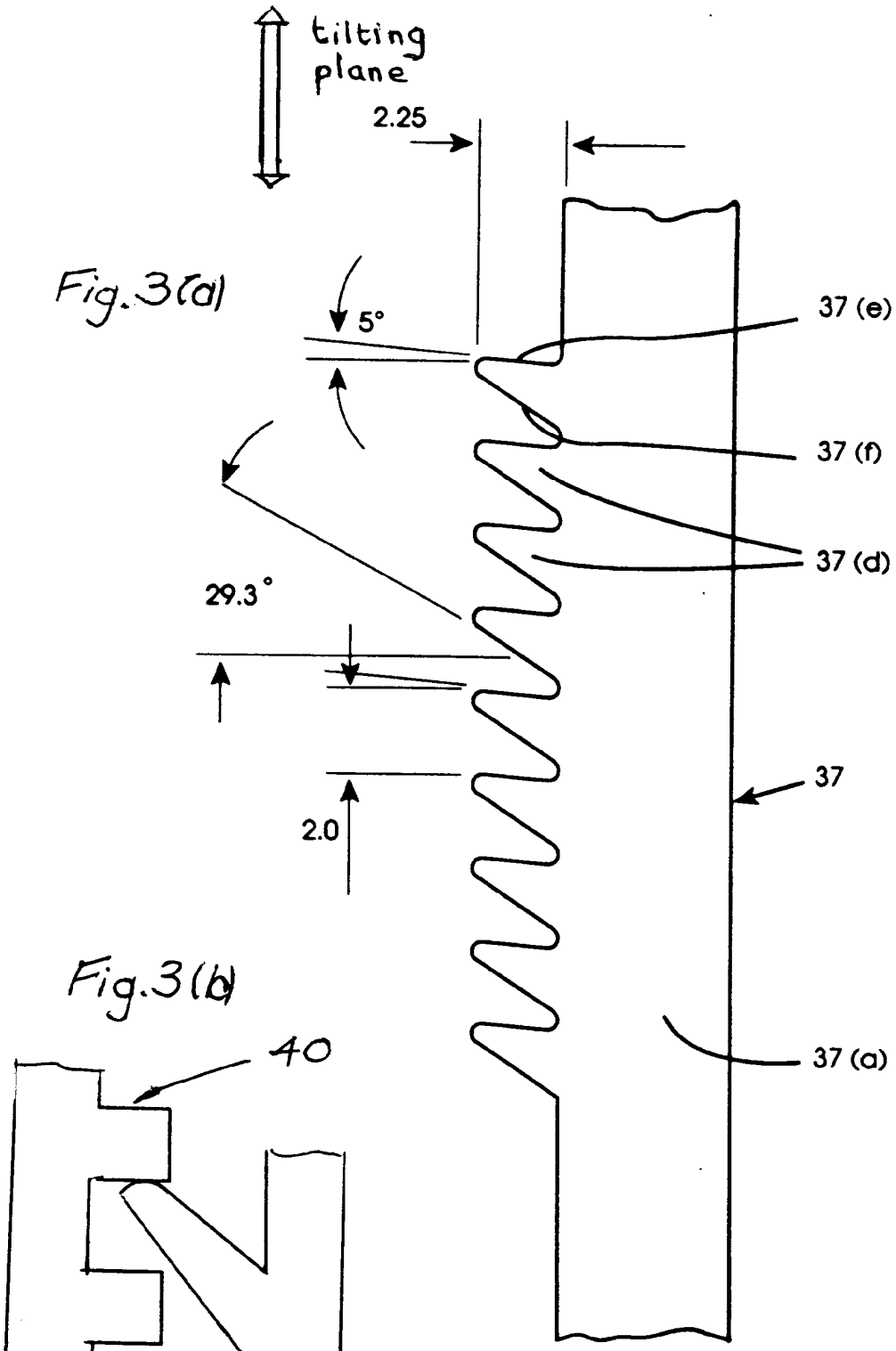

Fig.3(b)

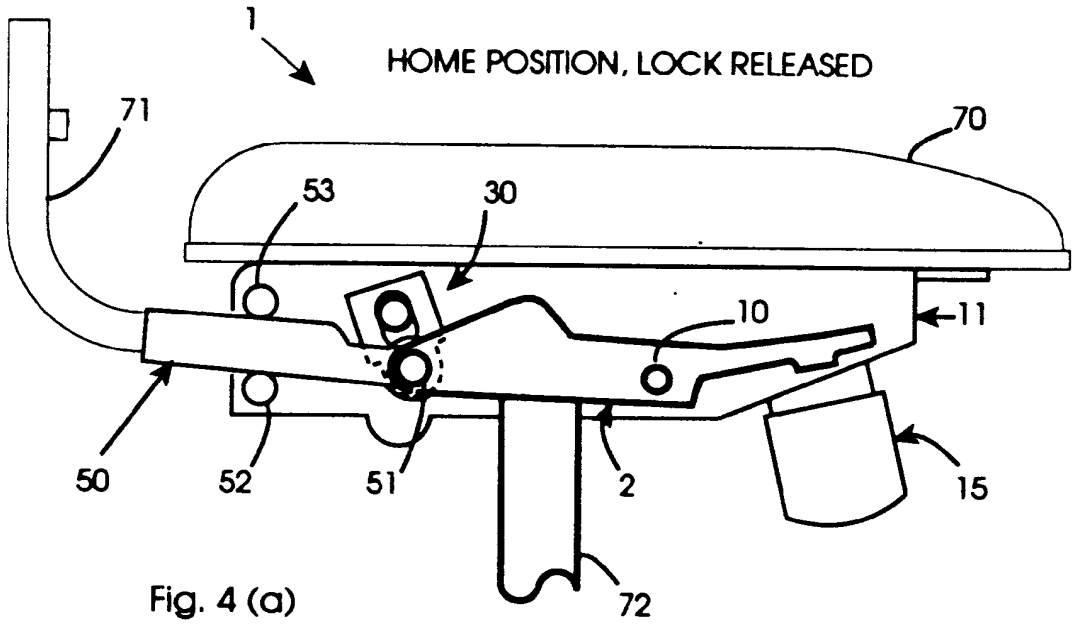
1
HOME POSITION, LOCK RELEASED
71
70
53
30
10
11
50
52
51
2
15
72

Fig. 4 (a)

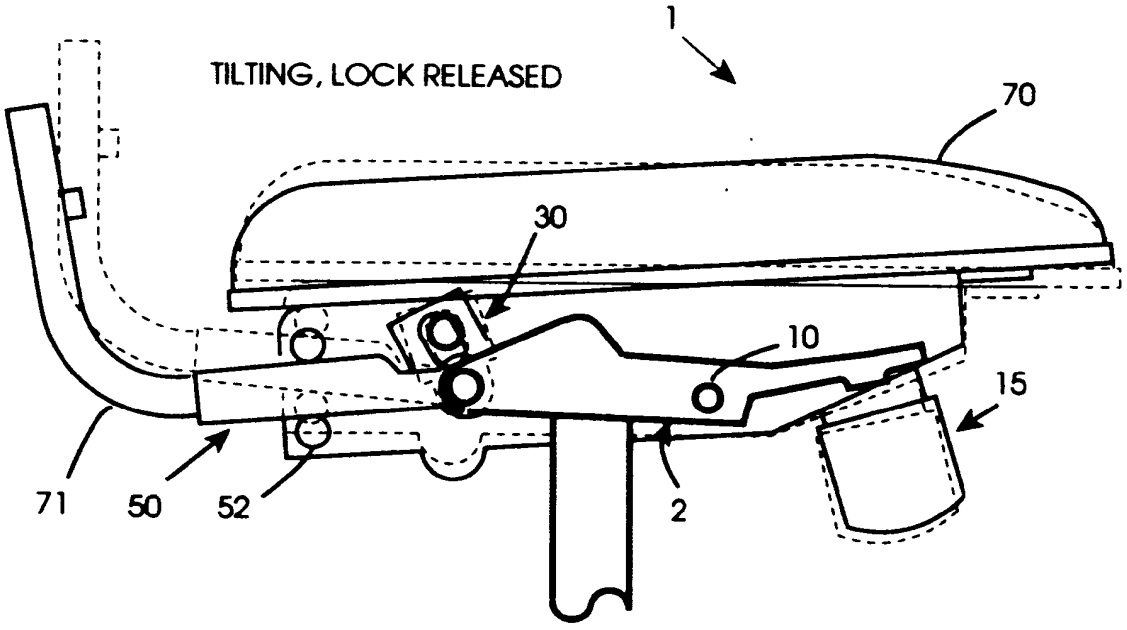
1
TILTING, LOCK RELEASED
70
30
10
15
71
50
52
2

Fig. 4 (b)

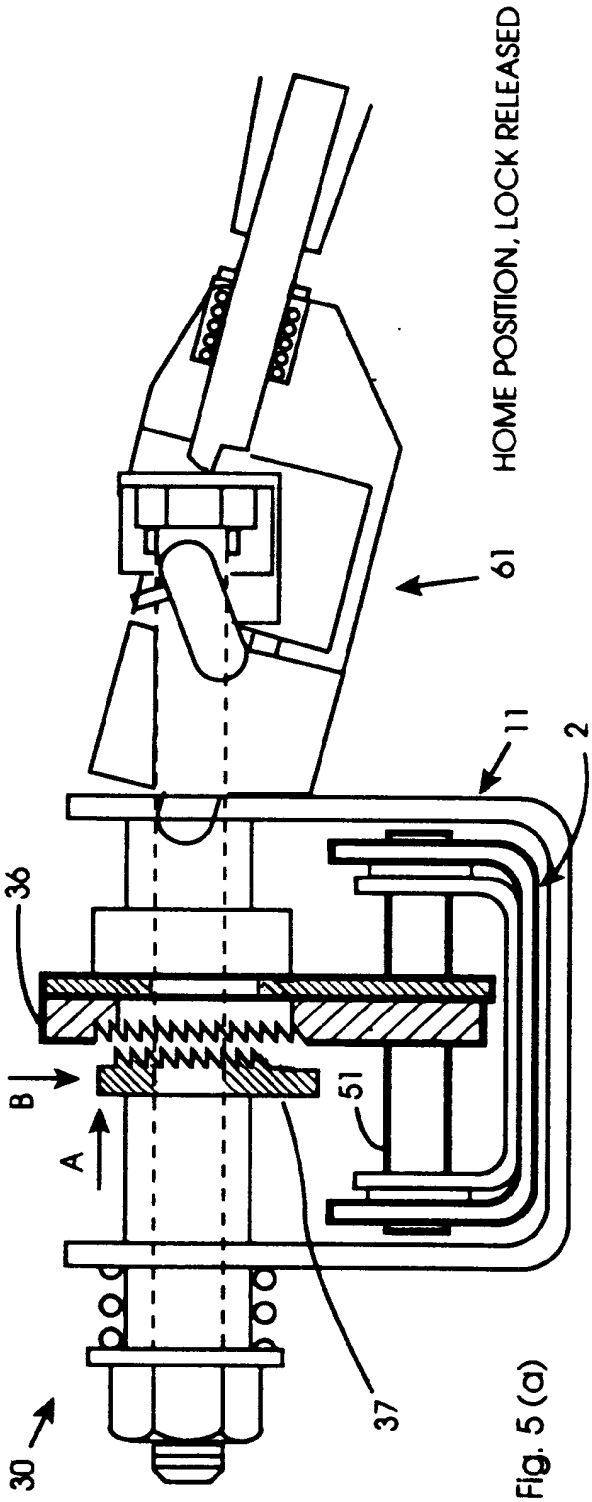
HOME POSITION, LOCK RELEASED
61
11
2
36
B
A
51
37
30

Fig. 5 (a)

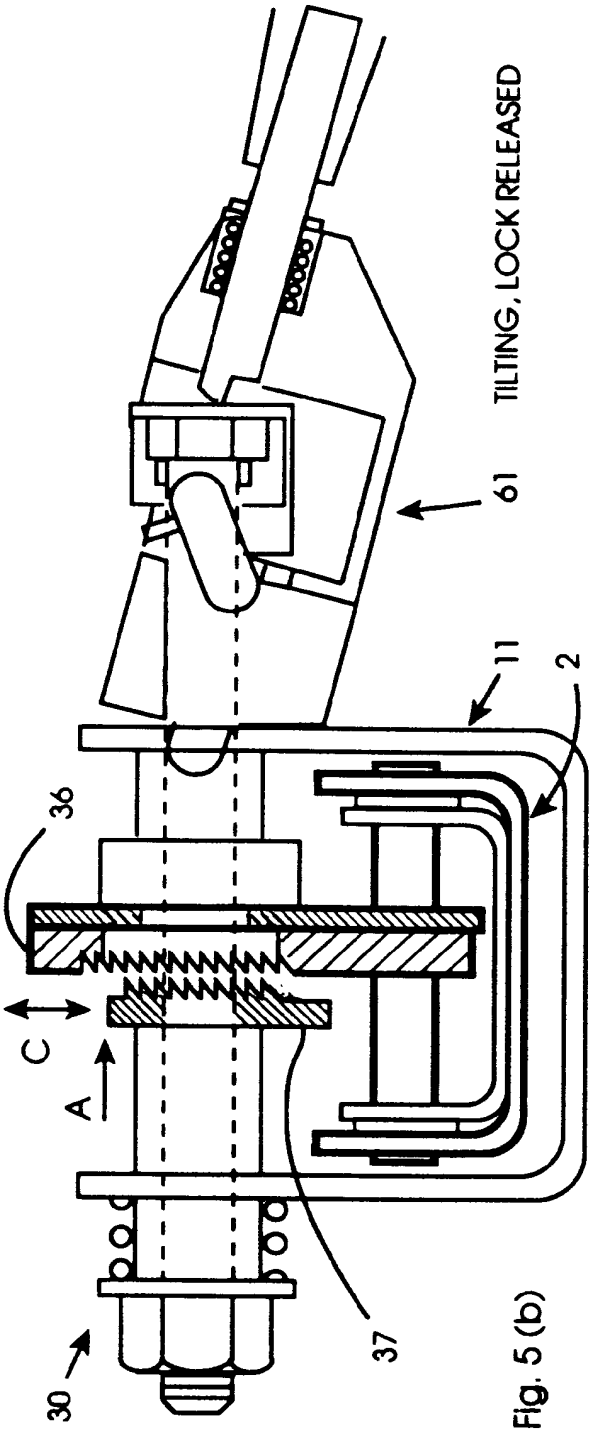
TILTING, LOCK RELEASED
61
11
2
36
C
A
37
30

Fig. 5 (b)

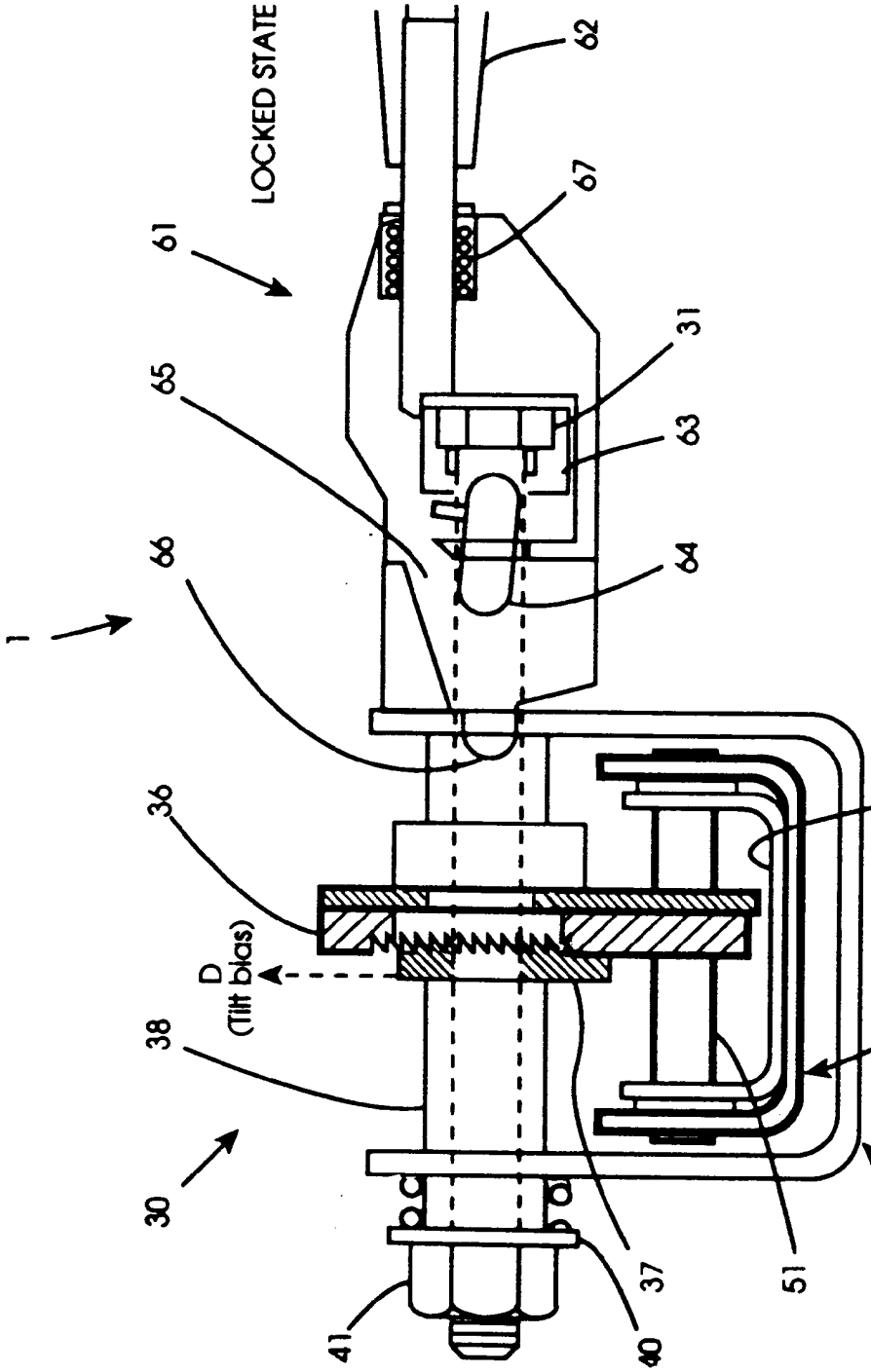
LOCKED STATE
61
62
67
31
65
63
64
66
1
36
50
D
(Tilt bias)
2
38
30
11
37
51
41
40

Fig. 5 (c)

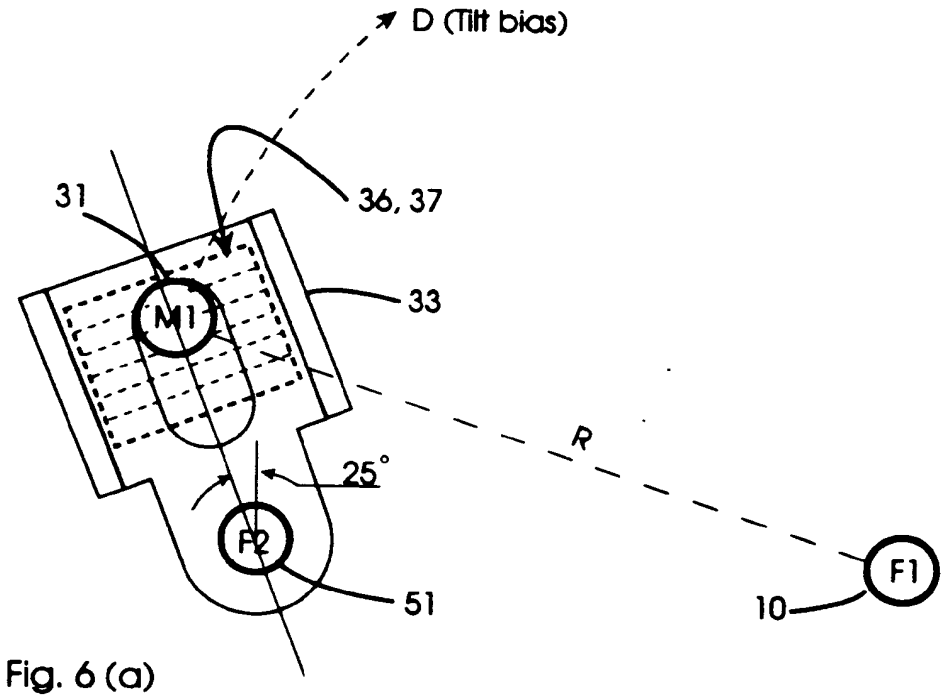

Fig. 6 (a)

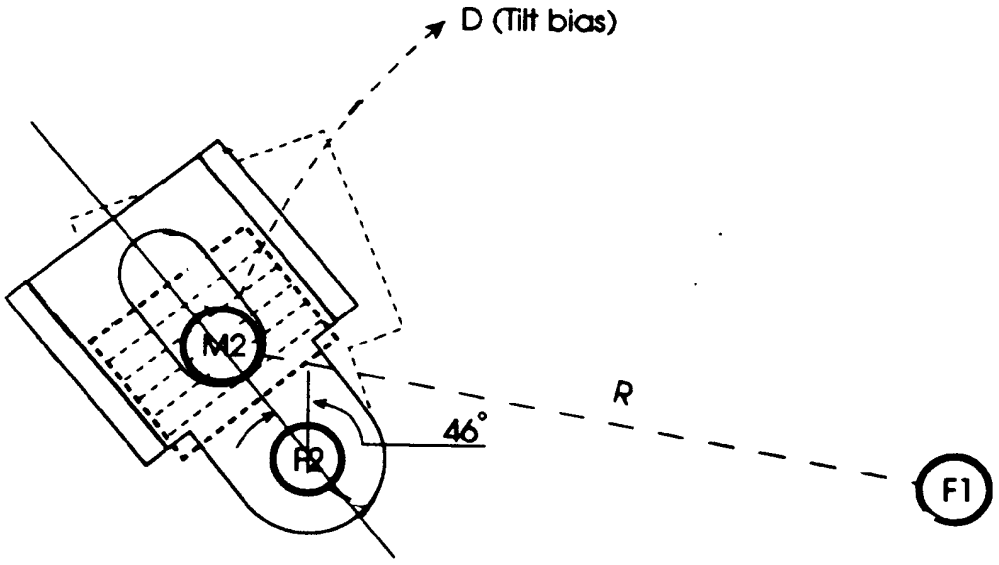

Fig. 6 (b)

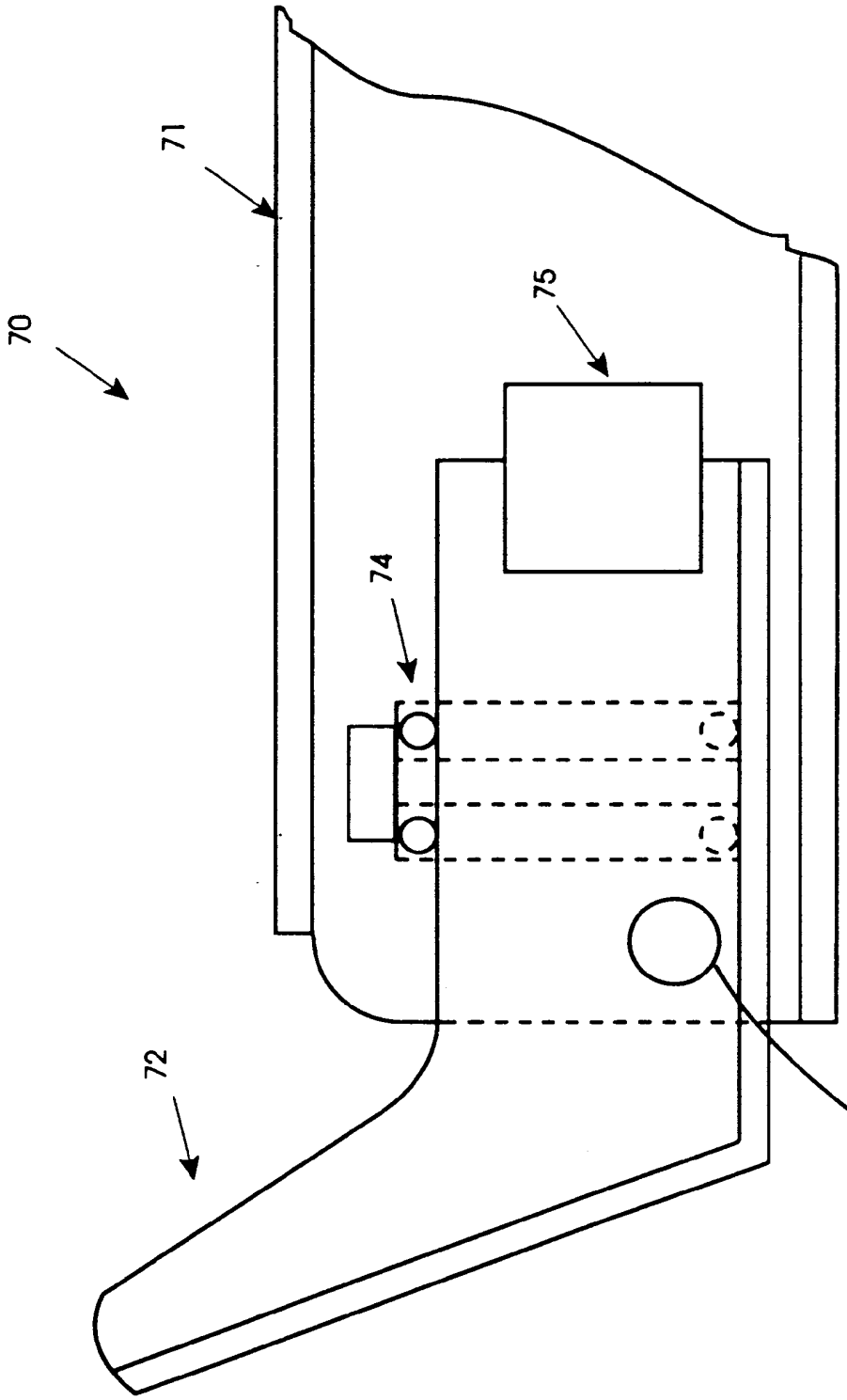

Fig. 7